DOCUMENT RESUME

ED 068 177 PS 005 922

AUTHOR Hops, Hyman
TITLE Covariation of Social Stimuli and Interaction Rates in the Natural Preschool Environment.
INSTITUTION Oregon Univ., Eugene.
REPORT NO AD-736-623
PUB DATE Dec 71
NOTE 45p.; Technical Report no. 7
AVAILABLE FROM National Technical Information Service, Springfield, VA 22151 (Microfiche, $0.95; Paper Copy, $3.00, No. AD 736 623)

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Behavioral Science Research; Data Processing; *Early Experience; *Environmental Influences; *Interaction Process Analysis; Nursery Schools; *Preschool Children; Psychometrics; *Social Psychology; Technical Reports

ABSTRACT

An intensive longitudinal investigation was conducted on the social behavior of two three-year old boys in a nursery school setting over a four-month period to analyze observable stimuli in each subject's immediate social environment for the main determinants of his social interactive behavior. It was hypothesized that the daily rate of social interaction for each child would be highly variable, and that the fluctuations in a child's daily rate would be accounted for by the density with which key agents provided the social stimuli. A behavioral observation coding system which provided a sequential description of each subject's interactions in continuous form was used by two trained observers. With constant monitoring, observer reliability was maintained at 86 mean percent agreement. (Author)

COVARIATION OF SOCIAL STIMULI AND INTERACTION RATES IN THE NATURAL PRESCHOOL ENVIRONMENT

Hyman Hops

University of Oregon

Technical Report 7

December, 1971

Prepared Under ONR Contract N00014-67-A-0446-0003

NR Number 170-720

Interpersonal Conflict
and
Group Theory

COVARIATION OF SOCIAL STIMULI AND INTERACTION RATES IN THE NATURAL PRESCHOOL ENVIRONMENT

Hyman Hops[1]

University of Oregon

An important function of scientific research is the investigation of the stimulus conditions under which phenomena occur (Sidman, 1960). Stimuli that control or effect change in behavior have been shown to operate in at least two ways. As antecedent events, discriminative stimuli evoke or set the occasion for the occurence of a specific class of response (Terrance, 1966). Consequent events, following the emission of a response, can maintain or increase the probability of the recurrence of the behaviors that immediately precede them (Morse, 1966). More specifically, it may increase the probability that the response will recur under the same, or similar, stimulus conditions that prevailed during the presentation of the consequent event (Sidman, 1960). A comprehensive theory of stimulus control, therefore, would make explicit both the antecedent and consequent events that interact to control the rate of occurrence of any class of response. The present study was designed to investigate the concept of stimulus control in the natural environment of a nursery school. The antecedent and consequent events provided by the social environment of two male preschoolers were analyzed to determine their relationship with each child's daily rate of social interaction.

The rate of response as a dependent variable has been shown to be extremely sensitive to manipulations of the independent variables across

a wide variety of behaviors (Skinner, 1966). It is a simple measure, provides an average of the frequency of the response for any unit of time, and can easily be transformed into probability terms. The traditional personality literature would assume that the rate of occurrence of a given behavior is constant across time and, to a lesser extent, stable across settings. The literature is replete with investigations of the concept of stability in behavior (Hartup, 1970; Maccoby & Masters, 1970). However, the results are equivocal and appear to be a function of a variety of factors independent of the behavior itself. For example, what little evidence there is for "stability in behavior" may be in large part a function of the measurement procedures.

Sidman (1960) points out that even when conditions are precisely controlled, each laboratory operates with its own definition of stability. A major methodological factor which masks variability in behavior is the group design. Data that are averaged over individual subjects "smooth out" individual variability and, thus, produce the illusion of greater stability (Sidman, 1960). Maccoby and Masters (1970) conclude, following a review of the literature on dependency and attachment, that "trait consistency" was found only when rating scales were used; much greater variability was noted in studies using behavior observation recordings. Ratings may reflect the judges' abstract theory about social behavior and not the behavior itself. Kagan (1969), summarizing the results of three investigations of stability in the behavior of preschool children, concluded that little continuity was noted in the observable behaviors of the subjects. This was partly due to changes in the topography of the responses that subjects emitted at different time intervals.

Nevertheless, he concluded that "the underlying dimensions (p. 990)" represented by a variety of different response typographies remained stable over time.

It appears likely that attempting to find stability in behavior without considering the effects of stimulus variables does not serve a useful purpose. Data demonstrating the significant effects of setting conditions or situational variables in reducing the proportion of unknown variability in behavior are steadily increasing (Hartup, 1970: Mischel, 1970). In the classic studies of the Midwest Psychological Field Station at the University of Kansas, it was noted that in many instances children's behavior could be better predicted from knowledge about the stimulus control of the "behavior setting" than from information about the behavior tendencies of the specific children (Barker, 1963). It would be relatively easy to predict how a given child would behave at a ballgame or circus without knowing anything about his history or personality makeup. Charlesworth and Hartup (1967) found reinforcement rates to vary across settings and activities. Patterson and Bechtel (in press) discovered that a child's rate of deviant behavior was different during individual seat work than during group work in the same classroom and with the same peers and teachers. In a study of retarded children, Rolland (1969) noted that specific behavior-consequence transactions were setting specific. Consequences that occurred during an unstructured game were found to be less likely to occur during a structured game. He also found that stability of consequences for behavior was highly individualized.

Setting conditions may vary across a molar-molecular dimension; they may range from the large, complex, physical, and social configuration of

Barker and Wright's (1955) drug store and Sunday school to the more minute social stimuli that are comprised of the physical proximity and behaviors of those social agents in the individual's immediate environment. The latter have also been shown to be associated with the occurrence of specific behaviors (Gewirtz & Gewirtz, 1955; Patterson & Cobb, 1971a, 1971b; Raush, 1965). Large physical settings remain relatively constant, but it is most probable that the social stimuli at the molecular level constantly change from moment to moment in time.

It should follow, then, that the fluctuations in behavior may very well be due to the constantly changing stimulus conditions which control their occurrence. Consequently, it seems likely that the variability in the rates of behaviors may be largely accounted for, not by making reference to events outside the prevailing environment or within the subject, but by analyzing the momentary shifts in the social environment and the individual's responsiveness to that environment.

Thus far it has been argued that behavior is variable and under the control of social stimuli in the immediate environment. Responsiveness to social stimuli, therefore, is assumed to be a state variable rather than one attributable to developmental growth factors, personality traits, or self-awareness. Gewirtz (1969) has recently demonstrated that responsiveness to social stimuli is a function of the child's preceding interaction with the social agents. The power of verbal praise was inversely related to the extent to which the child had previously been exposed to the same word noncontingently and directly related to the degree of deprivation during the preceding experimental session. The effects of punishment have also been shown to be related to individual responsiveness. Social dis-

approval following dependent responses significantly reduced the frequency of dependent responses in the presence of the punishing agent (Nelson, cited in Maccoby & Masters, 1970). Redd and Birnbrauer (1969) have shown that when an adult who had previously reinforced a child for play behavior entered the room, the probability of play behavior increased. The same result was not found when noncontingent reinforcing adults entered. Play behavior was shown not to be under the control of adults' presence, but the presence of a key adult.

Consequently, it seems reasonable to expect that there exist key social agents who control rates of social interaction. An "agent" is a complex social stimulus. In an interaction he can serve as a stimulus in two different ways. His presence can serve as an antecedent stimulus event which "facilitates" the occurrence of a social interaction. In the study by Patterson and Cobb (1971a) the presence of certain agents increased the probability of a "hit" occurring in the next six seconds. An agent can also serve as an "accelerating consequence." Given that the subject has made a response, the same agent's continued presence as a consequence would act to increase the probability that the subject would continue making the response.

Unfortunately, very little has been done by way of analyzing the impact of complex social stimuli as they occur in the natural environment. Most precise studies of stimulus control have taken place under laboratory conditions which have generally emphasized automated recordings of behavior (Terrance, 1966). To analyze the problems of stimulus control in situ requires the collection of continuous sequential records of social interaction in the individual's own environment over some period of time. The

data can then be subjected to a sequential dependency analysis to determine the degree of association between specific stimulus events and the occurrence of specific responses. While there has been a number of investigators who have recently developed technologies for the recording of complex behavioral chains occurring in the natural environment (Bijou, Peterson, & Ault, 1968; Caldwell, 1969; Crosson, Bloch, & Mullenix, 1968; Patterson, Ray, Shaw, & Cobb, 1969), few have attempted the complex statistical analyses required to show functional dependencies between precise stimulus components and the behavior they control (Gewirtz & Gewirtz, 1965; Patterson & Cobb, 1970, 1971; Raush, 1965; Rolland, 1969).

The present study is a partial attempt to view, in microscopic detail, the social world of young children and to delineate the natural determinants of changes in their rates of social interaction. The densities of social stimuli provided daily by the presence of different groupings of significant agents constituted the independent variables.

To determine the "significance" of social agents, the conditional probability of social interaction occurring in the presence of each agent was compared to the base rate probability for all other agents. A social agent j was identified as a key agent when it was shown that the probability of social interaction in his presence was significantly greater or lower than the base rate for agents other than j. When High-Probability (H-P) agents are most available, each subject should display his highest rates of social interaction. Conversely, when Low-Probability (L-P) agents are present more frequently, his rates of social interaction should be relatively lower.

If the densities with which each key agent controls the stimuli which

facilitate and/or accelerate social interaction could be determined, then it should be possible to predict concurrent rates of social interaction.

Expressed in correlational terms, the magnitude of such covariations would identify the amount of variance in rates of social interaction accounted for by one class of stimuli, the presence of key agents. A high correlation would imply that a great deal of behavior can be "understood" by the expedient of identifying the density with which that class of stimuli is presented. Doubtless, behavior is controlled by many stimuli, only some of which are observable. However, the writer assumes that some of the main determinants are to be found in the immediately observable social environment.

An intensive longitudinal investigation was conducted on the social behavior of two three-year-old boys in a nursery school setting. Trained observers recorded the continuous sequential interaction of the two subjects in an entire four-month period. To determine the degree of association between specific social agents and the occurrence of social behavior, conditional probabilities were computed for each and tested by means of a chi-square analysis. Three independent variables were selected and entered into a stepwise regression analysis to predict the daily rate of social interaction.

METHOD

Subjects

The nursery school was located in the Central Presbyterian Church, Eugene, Oregon, and met twice weekly from 9 a.m. to 11:30 a.m. Admission was non-denominational and therefore not limited to children of church

members. The children ranged in age from 3 years, 0 months to 4 years, 0 months, with a mean age of 3 years, 6 months. They were predominantly from middle-class homes with fathers' occupations including salesman, lineman, student, and dentist.

Orientation sessions for the children were held during the first week of school. Half the class was brought in one day and the other half later in the week. Both groups were observed by the experimenter during this time and two subjects of the same sex selected who appeared to exhibit behaviors distinctly different from each other. The purpose of this forced choice procedure was to attempt to demonstrate that this form of analysis could be used effectively for very different individuals. Two boys were selected, the first of whom (S1) was observed to display considerable noncompliant behavior to the teachers' commands; the other (S2) played mostly by himself. They were 3 years, 0 months, and 3 years, 3 months, respectively.

School Environment

The maximum number of children allowed in the school was 16 and the population varied from 12 - 16 during the course of the study. The total staff consisted of an experienced teacher and a teacher's aide, both of whom were female. Restricting their interactions with the children during free play period, when recording was taking place, they provided only minimal structure to influence play preferences.

The interior of the school proper consisted of two large rooms which contained various activity areas with their play materials. A large adjacent hall was occasionally used as a gym at which time the most frequent activity was high rate running behavior. The second general play area

was the outdoor playground, utilized on nearly all nonrainy days. A fence cordoned off the swings, slides, woodchip box, and climbing dome, while outside that area the children could freewheel their vehicles around a lawned area or play various activities there. Except for the gym, the entire school area is illustrated in Figures 1 and 2.

- - - - - - - - - - - - - - - - - -

Insert Figure 1 about here

- - - - - - - - - - - - - - - - - -

- - - - - - - - - - - - - - - - - -

Insert Figure 2 about here

- - - - - - - - - - - - - - - - - -

Observation Recording System

The procedure for the coding and recording of social and nonsocial behaviors in the nursery school was a modification of the system developed by Patterson, Ray, Shaw, and Cobb (1969) which provided a sequential description of social interaction within families. At approximately six-second intervals, the observers recorded the identifying number and behavior of the subject and the identity and behavior of those social agents in the same activity area. While the observers usually began the recording with the subject's behavior, this was not always the case and each sequence of behavior was recorded as it occurred in time. In addition, they recorded the code for the activity area in which the subject was located as well as the comings and goings of others to and from that area.

Behavior codes. A pilot study was conducted to test the efficacy of

utilizing the Patterson et al. (1969) procedure and to determine what behavioral response classes were generally observed in a nursery school. As a result, four behavioral categories were added to the previous list and two existing categories slightly modified. The code used in the present study (see Figure 3) consisted of 33 behavioral categories, each operationally defined and mutually exclusive, and the total number sufficiently inclusive to provide a classification system for most of the relevant behaviors occurring in the nursery school environment.

- - - - - - - - - - - - - - - - - - -

Insert Figure 3 about here

- - - - - - - - - - - - - - - - - - -

The four new response classes are described as follows:

(a) Imitate (IM): This code was used when one individual imitated the behavior of another within two intervals following the occurrence of the first response.

(b) Instruct (IN): This category was used when the teachers were instructing the children on the use of or talking about the play materials. This category could be recorded for children, although this occurred very infrequently.

(c) Movement (MO): This code was used to describe the movement of an individual from one setting to another when movement was not inherent in the activity itself. For example, if a child were moving in a car, then his behavior was coded as play (PL) in vehicle (VH) activity area. However, if the subject were wearing clothes from the clothes closet and moved across the room, then his behavior was double-coded to include move-

ment as well as play.

(d) Play Together (PT): When two or more people were playing together in some integrated fashion, such as on a single project or painting, then this category was used.

The two modified categories are:

(a) Play (PL): This code was now restricted to playing alone, in a solitary fashion, or in parallel play, but not in any interactive manner.

(b) Normative (NO): This code was initially designed to record all high frequency but unimportant behaviors which had been excluded from any of the other categories. In the present study, the 32 other categories are sufficiently exhaustive to permit this code to be used primarily when the subject was staring into space or doing nothing at all.

Activity Area Codes

All of the activity areas were coded to allow the observers to record the physical location of any individual in the class. Table 1 presents all of the areas and their mnemonic codes. They include such areas as the cornmeal box, water table, kitchen, science table, and record player.

- - - - - - - - - - - - - - - - - -

Insert Table 1 about here

- - - - - - - - - - - - - - - - - -

A number of activity areas were actually portable since movement was inherent in the activity, or the materials could be carried into another activity area. For example, driving a vehicle, or wearing adult clothes from the closet, a child might move through one or more other areas.

When this occurred, both activities were recorded. One "area" classification was defined by the exclusion of all others: Nowhere (NO) was used when a child was wandering or in transition, moving from one activity area to another.

Recording procedure. Each observer was equipped with a clipboard to which a 30-second interval timing mechanism was attached, emitting auditory signals via an earphone. At the top of the clipboard was a small card with miniature photographs of each child in the school and his or her assigned code number. The response classes and their respective codes were listed at the top of each recording sheet (see Figure 3). The main body of the sheet began with a line divided into five segments representing 30 seconds of data. At each 30-second signal, the observers began recording on the next line. There were 10 such lines, and, therefore, five minutes or 50 sequences of behavior per sheet.

Essentially, the task of the observers was to record the identity and behavior of the targeted subject and those stimulus events occurring in his immediate environment. The latter included the social and non-social behaviors of his peers and teachers as well as their coming and going to and from the activity area in which the subject was located. Consequently, each six-second interval could include from six to 12 possible recorded events. An example and explanation follow.

CB 01C 08G 02PL/SS CB 05C 01PL 05PL

In the cornmeal box activity area (CB), subject 01 arrives (01C) as subject 08 departs (08G), following which subject 02, the targeted subject, is recorded playing by himself (PL) and humming to himself (SS); in the

same setting, immediately after, subject 05 arrives (05C) and both he and subject 01 play alone in a parallel fashion (PL). As in the example, many of the sequences did not involve overt interaction between the targeted subject and his social agents, but all stimulus events in his immediate environment were recorded.

Pretesting showed that it was impossible to record the behavior of more than two individuals in the same area with the subject; when this occurred, they were identified only as a group. However, when an individual's behavior was a direct consequence of the subject's behavior or specifically directed at him, then that response took precedence over all others and was recorded. If an individual's behavior included more than a single response category, then both responses were coded simultaneously.

On each day, an observer was assigned one of the two subjects whose behavior they began recording immediately upon his arrival. They coded one subject for 10 minutes, then switched and recorded the behavior of the other for the next 10 minutes. Following this alternation, both observers recorded the behavior of the same child for five minutes and repeated this procedure for the second subject. Dual earphones were plugged into the same interval timing mechanism to ensure synchronization. Then they returned to the previous pattern of 10 minutes of recording and alternating subjects until the end of the free play period. Approximately 30 to 50 minutes of recorded data were obtained for each child as well as 10 minutes of reliability data on each day that both observers were present.

The same procedures occurred every day unless an observer or subject were absent. When only one observer was available, she recorded the be-

havior and related stimulus events for a subject for 10 minutes, alternating between the two for the entire period. When one of the subjects was absent, only one of the observers remained to record his behavior.

Observer Training

Both observers were initially trained in the procedures for recording family interaction on another project (Patterson, Cobb, & Ray, in press). The training program began with the reading of the manual, observation and coding of standardized films portraying family interaction, followed by actual practice sessions in homes with reliable observers who served as trainers. Both observers had been shown to be highly rleiable in the home observations after 15-20 hours of training. Agreements reaching 82, 82, and 89% were the computed reliabilities for their last three observation sessions prior to the beginning of the present study.

Following the home training, both observers were given instruction on the modifications required for the nursery school data collection procedure. They practiced recording behaviors from videotapes of the previous year's population in the same nursery school obtained during the pilot study. Discussions were held with the experimenter to eliminate any ambiguities. During orientation week, they practiced recording data in the school environment and further discussions were held. Approximately five hours of further training was added for the present study.

Inter-observer Reliability

A popular procedure for establishing observer reliability is to calculate the per cent agreement or correlation coefficient between two or

more observers in a pre-experimental or baseline phase and then assume that the level of reliability remains constant for the entire experiment. Reid (1970) has recently demonstrated, however, that a significant decrease in observer accuracy occurs following the cessation of continuous monitoring. Therefore, in the present study, 10 minutes of reliability data were collected on every day that both observers were present.

The index of observer agreement was obtained by calculating the number of coded events agreed upon and dividing by the total number of coded events that occurred during the simultaneous observation period. This means that both observers were required to agree on every event which occurred during each six-second interval such that the per cent agreement was calculated on the correctness of each code category as well as the sequence of coding. This index is a more stringent requirement than a simple correlation between the two sets of observations, since the latter is not influenced by disagreements on specific items or the sequence of events, but only by the total number of specific classes or recorded events (Wiggens, 1972). The mean per cent agreement of inter-observer reliability was 87% and the range varied from 61% to 99%.

Dependent Variable

The major dependent variable was the daily rate of social interaction for each of the subjects. It was computed by dividing the total number of social responses occurring in either group or dyadic interaction by the total number of responses recorded for the subject during the day. The latter included social, nonsocial, and solitary interactions. This proportion figure was multiplied by a constant of 10 to obtain the daily rate

of social interaction.

Solitary behavior was recorded when the child was all alone in a designated play area. Group interaction refers here to subject behavior that occurred in the presence of two or more individuals. When the subject was in physical proximity to only one other individual, then that was categorized as dyadic interaction. Group or dyadic interactions could be social or nonsocial.

Social responses refer to those subject behaviors which operated on the social environment, including response classes such as Talk (TA), Play Together (PT), Imitate (IM), and any of their combinations. Nonsocial behavior refers to those responses which were performed alone. Solitary or Parallel Play (PL), Movement (MO), High Rate (HR), and Attend (AT) are some examples. The last response was included in the social category only when it was determined that it did affect the environment, such as when it was preceded or followed by a social agent's social response. Many of the subjects' attending responses were primarily nonsocial in that they were observing the environment but not interacting with it.

Independent Variables

As noted previously, social interactions occurred in group and dyadic settings. However, data arising out of the former were difficult to analyze for purposes of identifying significant social agents. In many cases, the observers could not identify the agent the subject was interacting with or attending to. When more than two agents were present, they were coded only as a group. Furthermore, it could be argued, and a glance at the raw data provides some support, that the quality of interaction is quite dif-

ferent in the group as compared to dyadic settings. Because of the possible confounding effects of the group data, the independent variables were analyzed using the dyadic interactions only.

It was assumed that the subset of data occurring in dyadic interaction was an adequate representation of both group and individual interaction. To test this hypothesis, correlations were computed between the two estimates of the dependent variable, the daily rate of social interaction occurring in dyadic relationships and the daily rate computed from all of the data. The correlation coefficients were found to be 0.799 ($r < .01$) for S1 and 0.527 ($p < .01$) for S2 with 16 and 22 degrees of freedom, respectively. The highly significant figures demonstrate that the daily rate occurring in the subset of dyadic relations was highly predictive and therefore consistent with each child's social behavior for the entire day's events.

Responsiveness to key agents. As a general index of responsiveness, each subject's rate of social interaction was computed for the presence of each social agent. To determine the significance of each agent's overall effectiveness as a social stimulus, each subject's rate in his presence was compared to the rates in the presence of all other agents. A preliminary analysis indicated that social agents' status was highly variable. Peers whose presence was related to high rates of social behavior on one day were found to be associated with low rates of the same subject's social interaction on the next. Furthermore, the use of dyadic interaction data alone considerably reduced the frequencies for each agent. Therefore, status as a key agent was computed for six-day blocks only because this period approximated one month of nursery school.

Key agents were identified as High-Probability (H-P) or Low-Probability (L-P) agents for each six-day block. Status as an "H-P" agent indicated that in the presence of agent i, the overall probability of social interaction for a subject was significantly greater than the base rate probability computed for all other agents. Similarly, status as an "L-P" agent was assigned to those agents in whose presence the probability of social interaction was significantly less than the base rate probability. A two-by-two chi-square analysis was used to determine the degree of association between the presence and absence of an agent and the occurrence and nonoccurrence of social interaction in the subject.

For example, an agent may have had 10 interactions with a subject, five of which were social, making the conditional probability for that agent 0.50; in that same block of time, the subject may have had 100 interactions with all other agents, 10 of which were social, providing a base rate conditional probability of 0.10. A significant chi-square would indicate that there was a significant association between the presence of that agent and the probability of social interaction occurring.

In the first analysis, all social agents, individual peers, and teachers were compared to each other. Both teachers were found to be highly significant High-Probability agents whose presence was associated with very high rates of social interaction in the subjects. The frequencies that they contributed to the contingency table resulted in a high proportion of peers becoming Low-Probability agents in comparison. Consequently, a second analysis excluded teachers and compared peers to each other. Thus, three groups were identified for each six-day block: High-Probability Peers, in whose presence there was a significantly

high rate of social interaction when compared to other peers; Low-Probability Peers, in whose presence there was a significantly low rate of social interaction in comparison to other peers· and Teachers, whose presence was associated with high rates of social interaction in comparison to all other agents.

For every day of the six-day period for which members of a group had been shown to be significant agents, the rates with which that group presented social stimuli were computed. Consequently, three daily measures were obtained, one for each group of key agents--H-P Peers, L-P Peers, and Teachers. These figures represented the daily density of each group's physical proximity with the subjects and constituted the independent variables which were used to predict the daily rate of social interaction.

RESULTS

Variability in Behavior

It was hypothesized that the rate of social interaction would be highly variable from day to day. The daily rate was computed by dividing the total frequency of social behaviors by the total number of behaviors and multiplying by a constant of 10. Figure 4 graphically illustrates the variability in each subject's social behavior. The mean and standard deviation for each subject is presented in Table 2. On high rate days a child can interact at a rate 10 times or greater than on his low rate days even though the physical setting remains relatively constant. The social setting, however, may constantly be shifting and it is the latter which is presumably associated with changes in rates of social interaction.

- - - - - - - - - - - - - - - - - - -

Insert Figure 4 about here

- - - - - - - - - - - - - - - - - - -

- - - - - - - - - - - - - - - - - - -

Insert Table 2 about here

- - - - - - - - - - - - - - - - - - -

Thus, it can be seen that the major dependent variable, the daily rate of social interaction, varied considerably from one day to the next, for both subjects. It is precisely these day-to-day fluctuations which must be accounted for by an adequate theory of social behavior.

To investigate more general trends over the course of the study, the data were grouped into six-day blocks and the means presented in Table 2. The repeated measures analyses of variance showed no significant differences between the means for S1. For S2, there was a significant decrease in the rate of social interaction from a mean of 2.78 per minute in the first six days to 1.05 per minute in the last ($F = 3.08$, $df = 3/20$, $p < .025$).

Responsiveness to Social Agents

Proximity. A preliminary analysis indicated that the presence of peers occurred at a significantly higher rate than that of teachers for both subjects. For S1, the mean frequency of peers' physical proximity per day was 93.39, whereas the mean frequency for teachers was only 19.06 ($t = 6.790$, $df = 34$, $p < .01$). For S2, the results were very similar: the mean frequency for peers was 59.71, and 29.00 for teachers

($t = 3.717$, $df = 46$, $p < .01$).

It is quite possible that when more opportunity occurred for social interaction, that proximity alone was sufficient to account for increases and decreases in a child's daily rate. To test this hypothesis, correlations were computed between each child's daily rate of social interaction and the frequency of peers' and teachers' physical proximity. The correlations obtained for S1 were -0.171 ($df = 16$, $p > .10$) for peers, and 0.403 ($df = 16$, $p = .10$, two-tailed test) for teachers. For S2, the correlations were 0.252 ($df = 22$, $p > .10$) and 0.424 ($df = 22$, $p < .05$, two-tailed test) for peers and teachers, respectively. As can be seen, the day-to-day variability of the dependent variable, the rate of social interaction, cannot be predicted from the presence of the peers alone for either subject, whereas the frequency of teachers' presence does appear to be related for S2 and approaches significance for S1.

Key Social Agents

It was hypothesized that certain social agents would be effective social stimuli and others not. In addition, it was assumed that this status would vary from one time period of six days to the next. To test these hypotheses, significant social agents were identified for each six-day block of data by comparing the rate of each subject's social interaction occurring in their presence with the base rate for all other agents. A two-by-two chi-square analysis was used to determine the degree of association between the presence and absence of an agent and the occurrence and nonoccurrence of social behavior for the subjects. Agents were considered significant whose chi-squares were

significant at $p \leq .05$. "High-probability" social agents had a significantly greater probability of subjects' social behavior occurring in their presence. Conversely, "Low-probability" agents were associated with extremely low rates of social interaction.

- - - - - - - - - - - - - - - - - - -

Insert Table 3 about here

- - - - - - - - - - - - - - - - - - -

Table 3 contains the code numbers of the significant agents for each six-day period. It can easily be seen that teachers were the only consistently significant agents throughout. There was little likelihood that a peer would retain his status as a significant "H-P" or "L-P" agent for more than one time block. For S1, of the seven significant H-P peers, only two retained their status for more than one block; only two of five L-P agents did the same. For S2, only one of five H-P and one of eight L-P agents retained their status for two periods.

This analysis effectively demonstrates that status as a significant agent is highly variable; not only do key agents lose their effectiveness as social stimuli, but some even change in their value from High-Probability to Low-Probability and vice versa. Presumably, three-year-old preschoolers do not retain friendships for very long.

Covariation of Social Interaction and Density of Significant Agents

On days in which a subject was interacting at a high rate, both H-P peers and teachers would be expected to account for a large proportion of the social stimuli. Conversely, on low rate interaction days, L-P

peers should account for a large proportion of the same stimuli. The density of antecedent and consequent stimuli provided by key agents should covary with each subject's daily interaction rate.

To test this hypothesis, the daily rate at which each of the three groups were presented as social stimuli was computed. These constituted the three independent variables entered into a stepwise regression analysis to predict the daily rate of social interaction. On the first step, the analysis selected the most powerful predictor based on the highest zero-order correlation between the dependent and each of the independent variables. Next, a partial correlation was computed between the remaining independent variables and the one having the highest partial correlation was entered into the equation. At each step, an F-test was computed to determine the significance of the regression equation.

- - - - - - - - - - - - - - - - - - -

Insert Table 4 about here

- - - - - - - - - - - - - - - - - - -

As Table 4 shows, the hypothesis that fluctuations in individual response rates from day to day would show significant covariation with the density with which key agents were presented was supported for significant peers. S1's daily rate was significantly correlated with the rate of social stimuli provided by H-P peers: S2 also showed significant covariation between his rate of interaction and the density of the stimuli provided by both H-P and L-P peers.

- - - - - - - - - - - - - - - - - - -

Insert Table 5 about here

- - - - - - - - - - - - - - - - - - -

It was further hypothesized that the combination of stimulus densities provided by different types of key agents would best predict the daily rates. The results of the stepwise regression analysis are presented in Table 5. For S1, teachers and L-P peers did not contribute significantly to the reduction in unexplained variance, H-P peers accounting for 24% of the variability alone. The multiple r produced by the combination of H-P and L-P peers was 0.59 for S2, accounting for 35% of the variance in his daily rate. The contribution of teachers was insignificant for either child.

The analyses demonstrate quite dramatically that the densities of social stimuli provided by the presence of significant peer agents are the best predictors of both subject's daily rates of social interaction. This is in direct contrast with the earlier finding that the frequency with which peers are present in physical proximity to the subjects, and presumably providing opportunity for interaction, was not related to subjects' social interaction rates. These data provide strong support for the position that it is not the presence of social agents per se that determines whether a child interacts more or less in any given day, but the presence of key controlling agents that is significantly related to his social behavior.

For S1, whose rate of social interaction was not significantly different across the three six-day blocks during which he was present, only the H-P peers covaried with his daily fluctuations. When they were there more frequently, his rate increased; when he was not in their presence, he tended to interact less. The L-P peers appeared to have little effect on his social interaction rate. S1 was selected for this study because

he emitted a relatively high rate of noncompliant behavior during the orientation session. Perhaps his disinclination to follow adult-dispensed instructions or commands relates to his non-responsiveness to L-P agents.

For S2, both H-P and L-P peers accounted for the variability in his rate of social interaction. It was this subject whose rate of social interaction had shown a steady decline over the four-month period. In addition, the number of H-P peers in the last two six-day blocks was half of what it was in the first two. Fewer peers were effective in evoking social responses during the last twelve days. It is possible that as he interacted less, it was the L-P peers who accounted for more of the fluctuations in his social interaction.

It has been shown that the presence of key peers was an effective stimulus for predicting each child's daily rate of social interaction. This single variable was sufficient to account for 25-35% of the variance. A more detailed analysis of the immediate observable environment should further reduce the still unknown sources of variability.

DISCUSSION

The results of this study have clearly shown (a) that rates of social interaction fluctuated from day to day within the gross physical setting of the nursery school, and (b) that a moderate proportion of the variance could be accounted for by a detailed analysis of the more molecular setting events, the moment-by-moment shifts in the observable social stimuli impinging upon the subjects. Considering only a single class of stimulus events, the presence of social agents, the daily density with which the presence of key agents provided this class of stimuli accounted for 25%

and 35% of the variance in the daily rates of social interaction of S1 and S2, respectively.

The physical proximity of social agents was of limited value in understanding variations in the rate of social interaction. Correlations obtained between the daily rates of social interaction and the frequency of peers' and teachers' presence demonstrated that teachers' physical proximity was only related for S2, and approached significance for S1. Peers' presence was not related for either subject. However, the frequency of peers' physical proximity in any day may have been the contributions of up to 15 individual children. When significant peers were identified, it was found that the density with which they provided the antecedent and consequating events were the best predictors of each subject's daily rate. As Redd and Birnbrauer (1969) have shown, it was not the presence of any agent, but the presence of key agents that acted to control the daily rates of social interaction in both subjects.

The absence of any covariation with the density of teachers' social stimuli was somewhat surprising. Both teachers were the only consistent S-P agents for both children across all six-day blocks. In addition, the frequency of their physical proximity was shown to be partially related to the subjects' rates. Yet the density with which they provided antecedent and consequating stimuli did not predict either subject's daily rate of social interaction.

Data showing the percentage of interactions initiated by peers, teachers, and subjects may provide a simple explanation of the peculiarity in the teachers' effect. Teachers were found to initiate from 60-90% of all their interactions with the subjects whereas peers initiated only

35-45%. Teachers may have been found to be H-P agents simply because they initiated most of the interactions. A similar finding was noted among school-age children by Dyck (1963); teachers initiated an average of 73% of their social contacts with the children. It is highly likely that teachers respond to different cues in the social environment than the children. A teacher may initiate an interaction with a subject, control his attention for a short period, and then leave to attend to other children. It may well be that in school environments, due to the teachers' professional duties, the effective antecedent stimuli for them are to be found in the presence of the children.

Both subjects had relatively low rates of social interaction. Their mean rates indicate that less than 20% of their behavior was social. The data agree with the findings of normative studies of preschoolers' play behavior showing that three- and four-year-olds engage in associative and cooperative play approximately 25% of the time (Barnes, 1971). In addition, the present study found that the status of key agents was short-lived. Relatively few of the significant agents were found to retain their status for longer than a single six-day period. However, it has been shown that the amount of social interaction with other children is partly a function of age (Maccoby & Masters, 1970). Presumably as the children grow older and play with each other more frequently, longer friendships will be established.

What little social interaction that does occur in a nursery school, at least during free-play period, appears to be a function of the social stimuli provided by the presence of the significant peers. It is possible that the subjects' interactions with peers was more reciprocal than

with teachers. Charlesworth and Hartup (1967) found that nursery school children were more likely to reinforce those persons who dispensed reinforcement. Choices of friendships via a picture sociometric was shown to be a function of reinforcement received during cooperative play (Blau & Rafferty, 1970). Presumably, friends reinforce each other and engage in more interactive play. Those who do not exchange reinforcers or punish each other may tend to engage in more solitary or parallel play. The data from the present study show that slightly more than 50% of the contacts the subjects made with peers were initiated by the subjects, the remainder by peers. This suggests that they may have alternated the initiations, so that the peers and subjects can be said to have been significant social stimuli for each other. Presumably, as S2 came under the greater control of L-P agents, the initiations decreased and so did his rate of social interaction.

The presence of a significant social agent as a stimulus may well be a gross setting variable. It is quite likely that the stimulus configurations which actually control behavior are much more complex than just the presence of a key social agent. As Rodd (1969, 1970) has clearly shown, stimulus configurations which control cooperative behavior differ from individual to individual as a function of their previous conditioning histories. Therefore, it is quite likely that other stimulus variables must be considered in future research.

For example, in considering the effects of agents' presence, the behaviors they were emitting were ignored in the present study. It is probable that specific response classes can also be shown to have some control over the subject's social interactions. The combination of the

presence of significant agents emitting a significant response may account for considerably more of the fluctuations in a subject's response rate.

Another variable which may provide a significant reduction in unexplained variability is the activity area in which the subject and his social agent interact. Each agent was seen to have different play patterns and choices of play materials. This may have been due in part to his previous conditioning history at home, or to the "intrinsically reinforcing" effect of some new toy. On the other hand, he may have chosen to play in a specific activity area because of the available reinforcers provided by key agents. Tracking the subject's social behavior in various play areas should provide additional information of significance.

It has been shown that a fine analysis of the momentary changes in the subjects' immediate social environment has accounted for approximately 30% of daily fluctuations in rates of social interaction. It is quite probable that a more detailed analysis of the social and physical environment, adding to the presence of key social agents, the behaviors they emit, as well as the physical activity areas in which the interactions occur, would further reduce the unexplained variance. Until this has been done, it seems fruitless to postulate other, unobservable sources of variation.

REFERENCES

Barker, R. G. Wanted: An eco-behavioral science. In E. P. Willems & H. L. Raush (Eds.), Naturalistic viewpoints in psychological research. New York: Holt, Rinehart & Winston, 1969. Pp. 31-43.

Barker, R. G., & Wright, H. F. Midwest and its children. Evanston, Illinois: Row, Peterson & Co., 1955.

Barnes, K. E. Preschool play norms: A replication. Developmental Psychology, 1971, 5, 99-103.

Bijou, S. W., Peterson, R. F., & Ault, M. H. A method to integrate description and experimental field studies at the level of data and empirical concepts. Journal of Applied Behavior Analysis, 1968, 1, 175-191.

Blau, B., & Rafferty, J. Changes in friendship status as a function of reinforcement. Child Development, 1970, 41, 113-121.

Caldwell, B. M. A new "approach" to behavioral ecology. In J. P. Hill (Ed.), Minnesota symposia on child psychology. Vol. 2. Minneapolis: University of Minnesota Press, 1969. Pp. 74-109.

Charlesworth, R., & Hartup, W. W. Positive social reinforcement in the nursery school peer group. Child Development, 1967, 38, 993-1002.

Crosson, J. E., Bloch, M., & Mullenix, G. Development of a technique for the analysis of behavioral transactions in natural environments: Phase II. Research Project No. PRU 67-1, Rehabilitation Research and Training Center in Mental Retardation, University of Oregon, 1968.

Dyck, A. J. The social contacts of some Midwest children with their

parents and teachers. In R. G. Barker (Ed.), The stream of behavior. New York: Appleton-Century-Crofts, 1963. Pp. 78-98.

Gewirtz, J. L. Potency of a social reinforcer as a function of satiation and recovery. Developmental Psychology, 1969, 1, 2-13.

Gewirtz, J. L., & Gewirtz, H. B. Stimulus conditions, infant behaviors, and social learning in four Israeli child-rearing environments: A preliminary report illustrating differences in environment and behavior between the "only" and "youngest" child. In B. M. Foss (Ed.), Determinants of infant behavior III. London: Methuen (New York: Wiley), 1965. Pp. 161-184.

Hartup, W. W. Peer interaction and social organization. In P. H. Mussen (Ed.), Carmichael's Manual of Child Psychology. 3rd Ed. Vol. II. New York: Wiley, 1970. Pp. 361-456.

Kagan, J. The three faces of continuity in human development. In D. A. Goslin (Ed.), Handbook of socialization theory and research. Chicago: Rand McNally, 1969. Pp. 983-1002.

Maccoby, E., & Masters, J. C Attachment and dependency. In P. H. Mussen (Ed.), Carmichael's Manual of Child Psychology. 3rd Ed. Vol. II. New York: Wiley, 1970. Pp. 73-158.

Mischel, W. Sex-typing and socialization. In P. H. Mussen (Ed.), Carmichael's Manual of Child Psychology. 3rd Ed. Vol. II. New York: Wiley, 1970. Pp. 3-72.

Morse, W. H. Intermittent reinforcement. In W. K. Honig (Ed.), Operant behavior: Areas of research and application. New York: Appleton-Century-Crofts, 1966. Pp. 52-108.

Patterson, G. R., & Bechtel, G. G. Formulating the situational environ-

ment in relation to states and traits. In R. B. Cattell (Ed.), Handbook of modern personality study. Chicago: Aldine, 1971, in press.

Patterson, G. R., & Cobb, J. A. A dyadic analysis of "aggressive" behaviors: An additional step toward a theory of aggression. In J. P. Hill (Ed.), Minnesota symposia on child psychology. Vol. 5. Minneapolis: University of Minnesota Press, 1971, in press. (a)

Patterson, G. R., & Cobb, J. A. The structure of aggressive behavior. In J. K. Knutson (Ed.), Iowa symposium on the control of aggression. (May, 1971). Iowa City: Aldine, 1971, in press. (b)

Patterson, G. R., Cobb, J. A., & Ray, R. S. A social engineering technology for retraining the families of aggressive boys. In H. Adams & L. Unikel (Eds.), Georgia symposium in experimental clinical psychology. Vol. II. Springfield, Illinois: Chas. C. Thomas, Publishers, 1972, in press.

Patterson, G. R., Ray, R. S., Shaw, D. A., & Cobb, J. A. Manual for coding of family interactions. Unpublished manuscript, Oregon Research Institute and University of Oregon, sixth revision, June 1969.

Raush, H. L. Interaction sequences. Journal of Personality and Social Psychology, 1965, 2, 487-499.

Redd, W. H. Effects of mixed reinforcement contingencies on adults' control of children's behavior. Journal of Applied Behavior Analysis, 1969, 2, 249-254.

Redd, W. H. Generalization of adult's stimulus control of children's behavior. Journal of Experimental Child Psychology, 1970, ?, 286-296.

Redd, W. H., & Birnbrauer, J. S. Adults as discriminative stimuli for different reinforcement contingencies with retarded children. Journal of Experimental Child Psychology, 1969, 7, 440-447.

Reid, J. B. Reliability assessment of observation data: A possible methodological problem. Child Development, 1970, 41, 1143-1150.

Rolland, J. C. An identification of person-environment social transactions and response patterns of trainable mentally retarded adolescents in different environmental settings. Unpublished doctoral dissertation, University of Oregon, 1969.

Sidman, M. Tactics of scientific research. New York: Basic Books, 1960.

Skinner, B. F. Operant behavior. In W. H. Honig (Ed.), Operant behavior: Areas of research and application. New York: Appleton-Century-Crofts, 1966. Pp. 12-32.

Terrance, H. S. Stimulus control. In W. K. Honig (Ed.), Operant behavior: Areas of research and application. New York: Appleton-Century-Crofts, 1966. Pp. 271-344.

Wiggins, J. S. Principles of personality assessment. Reading, Massachusetts: Addison-Wesley, 1972, in press.

FOOTNOTES

1. This research was supported by ONR Contract Number N00014-67-A-0446-0003. The author is greatly indebted to Jerry Patterson, who provided the major "facilitating stimuli," Karen Strong and Jonni Johnson, reliable recorders of complex data, and Mark Layman, for his expertise in computer programming.

TABLE 1

List of Activity Areas and their Mnemonic Codes

AN	live animals	NO	nowhere
AR	art, painting, collages, cutouts	PD	playdough
BA	balls, baseball	RE	record player
BB	building blocks	SB	skate board
BD	balance board	SC	science table
BO	books, library area	SL	slides
CH	cockhorse	SW	swings
CI	climbing apparatus, inside	TG	toys and games, small
CL	clothes	TR	trees and vicinity
CO	climbing dome, outside	TT	teeter-totter
CT	cornmeal table	TU	tunnel, cloth
CY	clay	VH	large vehicles, including cars, boats
DO	dollhouse, dolls	WC	woodchip box
FP	fishpond	WT	water table
GY	gym	WR	wrestling
KI	kitchen	WB	workbench
MU	musical toys		

TABLE 2

Mean Rate per Minute of Subjects' Social Interaction
In Six-Day Blocks

	Total days	Days 1-6	Days 7-12	Days 13-18	Days 19-24	Grand mean	S.D.
S1	18	1.18	1.39	1.48		1.35	0.59
S2	24	2.78	1.76	1.69	1.05	1.82	1.04

TABLE 3

Significant Social Agents for Each Six-Day Block

Subject	Type of agent	Six-day blocks			
		1	2	3	4
S1	H-P Peer	05,07,09	05,09,10,11	06,12	
	L-P Peer	03,10	03,15	02,10	
	Teacher	31,32	31,32	31,32	
S2	H-P Peer	09,10	09,13	15	04
	L-P Peer	08,13	04,05,07,12	14	05,06,17
	Teacher	31,32	31,32	31,32	31,32

TABLE 4

Zero-order Correlations Between the Daily Rate of Social Interaction and the Independent Variables

Independent Variables	S1	S2
H-P Peers	0.488*	0.438*
L-P Peers	-0.157	-0.481**
Teachers	0.182	0.096

* $P < .05$

** $P < .01$

TABLE 5

Results of Stepwise Regression Analysis

S1			S2		
Independent variables in order of entry	multiple r	R^2	Independent variables in order of entry	multiple r	R^2
H-P Peers	0.49*	0.24	L-P Peers	0.48	0.23
Teachers	0.50	0.25	H-P Peers	0.59†	0.35
L-P Peers	0.50	0.25	Teachers	0.59	0.35

* $F = 5.11$, $df = 1/16$, $p < .05$.

† $F = 5.657$, $df = 2/21$, $p < .05$.

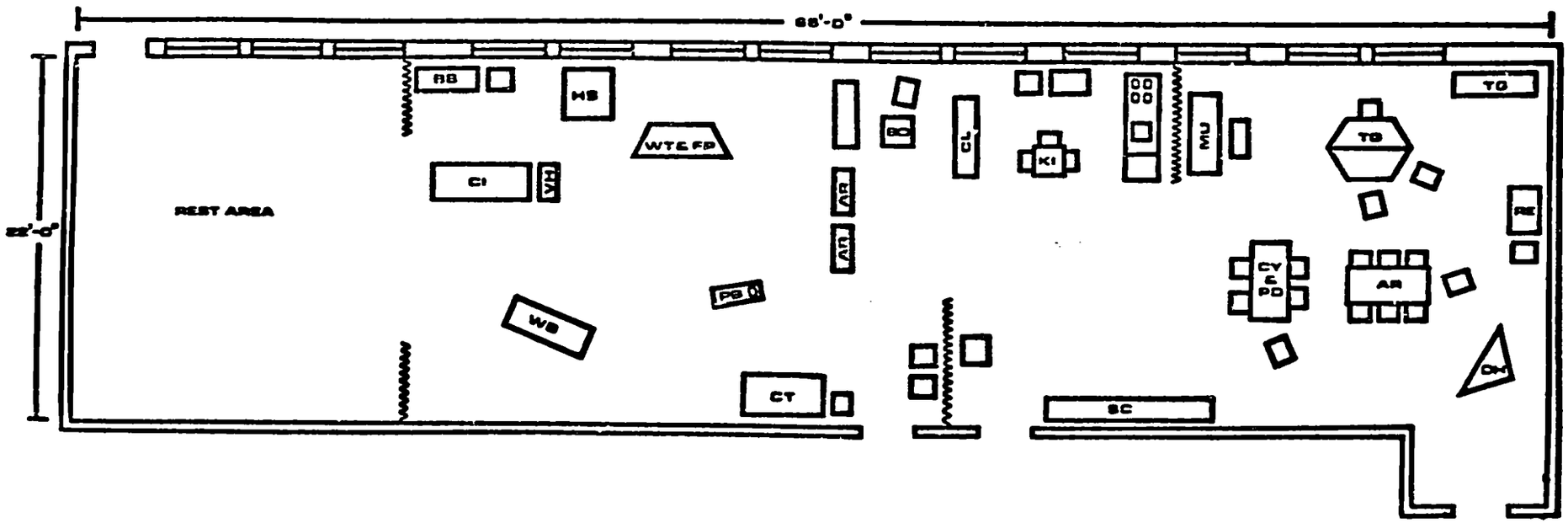

Fig. 1. Nursery School Interior Play Areas.

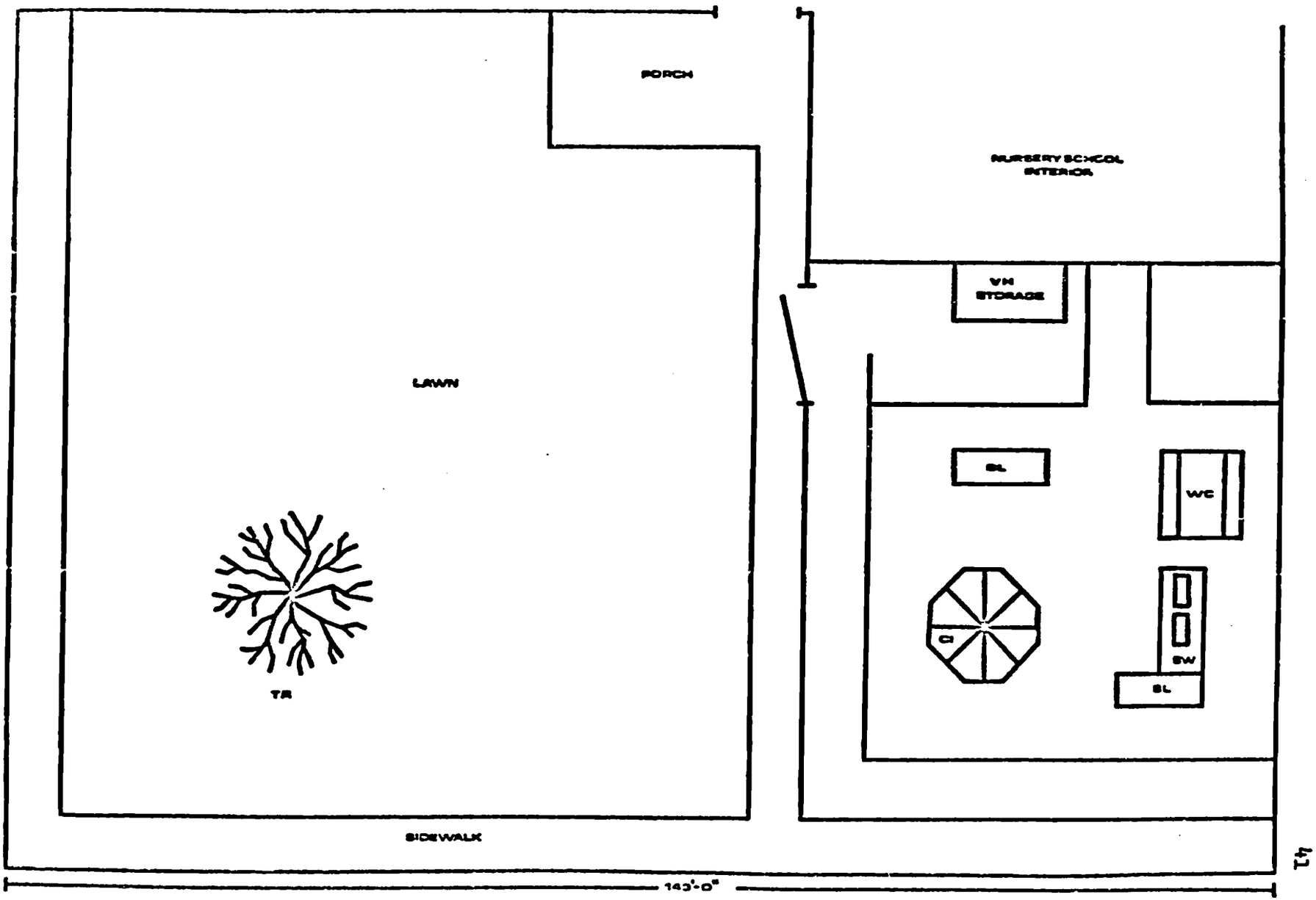

Fig. 2. Nursery School Exterior Play Area.

BEHAVIOR CODING SHEET

Subject _____ Observer _____ Date _____

Behavior Codes

AP	Approval	IG	Ignore	PP	Positive physical contact
AT	Attention	IM	Imitate	PT	Interactive play
CM	Command	IN	Instruct	RC	Receive
CN	Command (negative)	LA	Laugh	SS	Self-stimulation
CO	Compliance	MO	Movement	TA	Talk
CR	Cry	NC	Noncompliance	TE	Tease
DI	Disapproval	NE	Negativism	TH	Touching, handing
DP	Dependency	NO	Normative	WH	Whine
DS	Destructiveness	NR	No response	WK	Work
HR	High rate	PL	Play	YE	Yell
HU	Humiliate	PN	Negative physical contact		
ID	Indulge				

Fig. 3

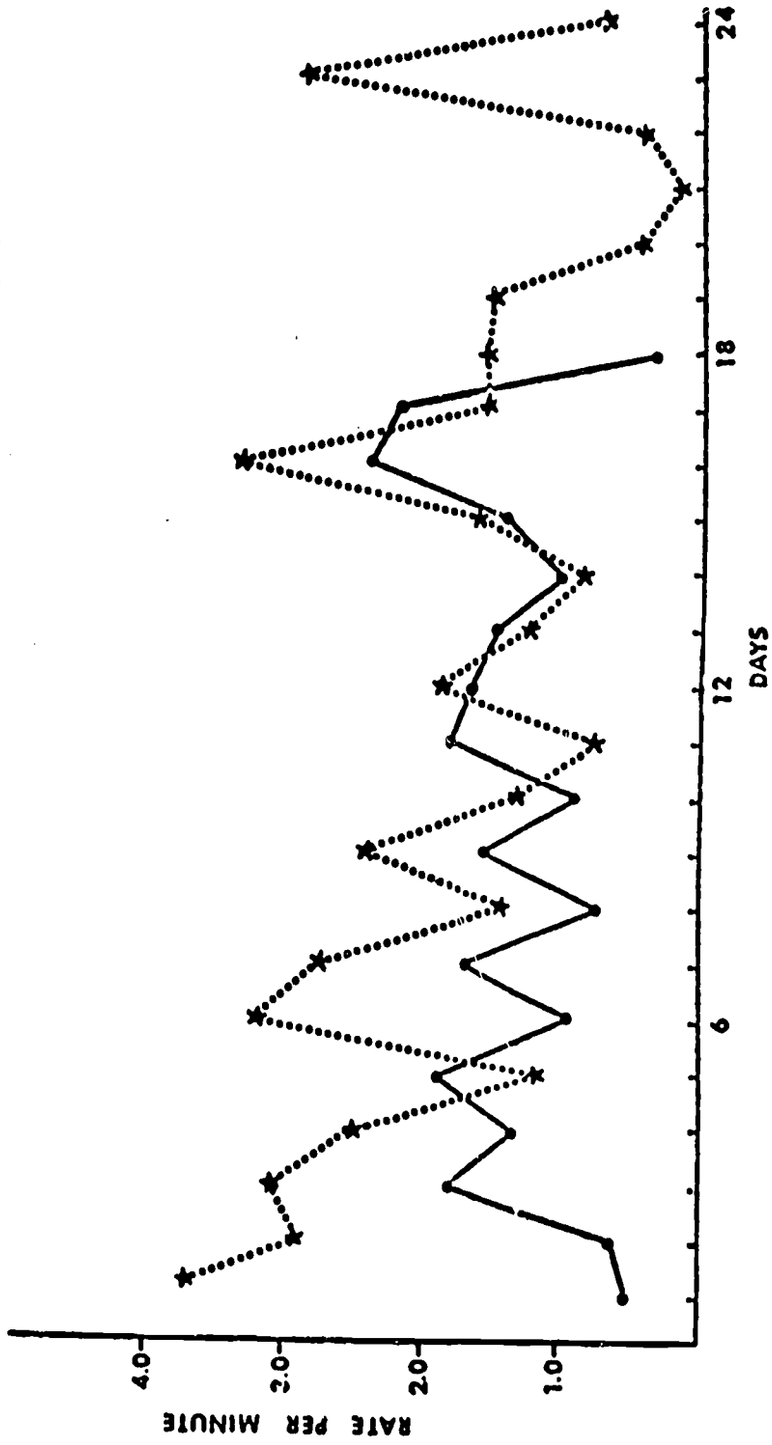

Fig. 4. Daily Rate of Social Interaction.